The Lord Howe Island Stick Insect: an example of the benefits of captive management

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Abstract

Captive breeding is an underrated aspect of invertebrate conservation programs, sometimes seen as expensive and of little value to the overall conservation goal. The Lord Howe Island (LHI) Stick Insect project demonstrates the benefits of captive breeding, despite the inherent difficulties in dealing with a species about which nothing was known, which began in captivity with a small founder population, which has required a number of veterinary treatments and which has demonstrated apparent inbreeding depression requiring ongoing genetic management. *Ex situ* breeding at Melbourne Zoo has so far grown the captive population to more than ten times the wild population with very little financial contribution from participating organisations, ensuring a more secure future whilst *in situ* conservation measures are undertaken. (*The Victorian Naturalist* **124** (4), 2007, 258-261)

Introduction

In recent decades, habitat preservation has been increasingly recognised as an effective means of conserving threatened populations of invertebrates *in situ* (Hutchings and Ponder 1999; Yen and Butcher 1997), preserving not only the threatened species but others that may be vulnerable now or in the future (Samways 1999). As one part of this trend, some authors have suggested that captive breeding has little or no role to play in effective conservation programs (Collins 1990).

Present day recovery plans emphasise the importance of further biological research and the need for community involvement, protecting wild populations and threat abatement (e.g. Sands and New 2002), often without the need for captive breeding (e.g. Crosby 1990; Sant and New 1988). Those recovery plans that do include a captive breeding component often place it last in a long list of recommendations, and rarely is any serious attempt made to undertake this component.

However, there are many examples of threatened invertebrate species that would no longer exist in the wild or would not survive in their natural habitat long term, but for ongoing *ex situ* conservation programs (New 1995; Pearce-Kelly *et al* 2007). There are a number of advantages of captive breeding programs, including the collection of biological data more easily than in the wild, and management of the genetics of a threatened population/species to prevent inbreeding and maintain genetic viability (Pearce-Kelly *et al* 2007).

Some authorities recognise both *ex situ* captive breeding, including genetic management, as well as habitat preservation and threat abatement as the best means of ensuring the long-term security of threatened species (Clarke 2001; New 1995). The Lord Howe Island Stick Insect (LHI Stick Insect) *Dryococelus australis* recovery program provides a salient example.

The Lord Howe Island Stick Insect

The LHI Stick Insect (Fig. 1) was once common on Lord Howe Island, 700 km off the coast of New South Wales, Australia. The species became extinct on Lord Howe Island a few years after rats were accidentally released in 1918 (Gurney 1947), but was rediscovered in 2001 living on a small group of *Melaleuca* bushes on a rocky outcrop, called Balls Pyramid, 25 km off Lord Howe Island (Priddel *et al* 2003).

LHI Stick Insects were classified at the time as endangered under the New South Wales Threatened Species Conservation Act 1995 and presumed extinct in the IUCN Red Data List (IUCN 1983). A Draft Recovery Plan was developed by the New South Wales Department of Environment and Climate Change (NSWDECC) (Priddel *et al* 2002), and in 2003 two adult pairs were removed from Balls Pyramid for captive breeding. One pair went to Insektus, a private breeder in Sydney, the other pair to Melbourne Zoo.

Fig. 1. The original female LHI Stick Insect brought to Melbourne Zoo, feeding on Lord Howe Island Melaleuca *Melaleuca howeana*.

At that point almost nothing was known of their biology and ecology, other than observations made by Lea (1916). The remaining wild population is now thought to be less than 40 individuals, living on a few bushes on the side of a cliff on Balls Pyramid (Priddel *et al* 2003).

Captive management

LHI Stick Insects at Melbourne Zoo are kept under temperature and humidity regimes as close as possible to those of Lord Howe Island. The eggs are usually deposited in sand or crevices by the female (Fig. 2), and the nymphs emerge after 6-9 months (unpubl. data). In order to collect as much data as possible, each egg is removed from the sand, weighed, measured and placed in one of a range of incubation media.

Given that the biology of this species was virtually unknown upon its arrival at Melbourne Zoo, and there has since been no opportunity to make any effective observations of the wild population, there have been a number of difficult husbandry issues, including the near-death of the original female within a fortnight of her entering captivity. For the first two years of the project, there were no more than 30 individual LHI Stick Insects at Melbourne Zoo at any time, and ongoing attempts were made to rectify the low breeding and rearing success, focusing largely on husbandry and diet (as their natural diet on Lord Howe Island remains unknown).

Fig. 2. LHI Stick Insect eggs. These are generally buried by the female during oviposition.

The captive LHI Stick Insect population began to increase significantly in early 2006, and as of February 2007, the population at Melbourne Zoo is in excess of 500 individuals. This dramatic increase appears to have a genetic origin.

Genetic management

Many LHI Stick Insect specimens, particularly early in the breeding program, showed signs suggesting inbreeding problems. Eggs produced by the F1 generation were smaller in length, volume and weight than those produced by the wild-caught female, and had a lower hatching rate (unpubl. data). The nymphs were smaller and had a significantly lower survival rate, and adults showed morphological deformities, particularly in the final segments of the abdomen, consistent with inbreeding deformities seen in other insect species (pers. obs.). These trends continued for the next two generations. Inbreeding was considered as a factor but, due to the excep-

tionally small founder wild population, dietary and husbandry problems were considered to be more likely.

In June 2004, four adult males were swapped with those being reared at Insektus. In succeeding generations, the eggs increased in length, volume and weight; hatching rate increased and the nymphs were larger on hatching; and the morphological deformities no longer occurred (unpubl. data). A population increase followed in the next generation and a further, more dramatic increase in the following generation (Fig. 3), presumably due to the genetic input from the unrelated males. However, the evidence for inbreeding is still circumstantial and can only be confirmed by future genetic studies.

Conclusion

The LHI Stick Insect recovery program utilises both *in situ* and *ex situ* conservation measures, the captive management component being particularly important due to the perilous state of the wild population. Reproductive management, via crossbreeding of different gene lines using individuals identified with 'bee markers' (Fig. 4) is also essential to prevent inbreeding depression.

Although invertebrate conservation programs are now tending away from the single species approach to a more holistic habitat approach (Yen and Butcher 1997), there is merit in attacking the problem at both levels (Clarke 2001). However, this is not a widely accepted view. A conservation workshop on threatened invertebrates concluded that 'invertebrates can benefit from *ex-situ* conservation and re-introduction, but this is expensive and should be seen as the last resort.' (Hutchings and Ponder 1999). However, depending on how it is conducted, captive breeding can be relatively inexpensive and resource-efficient (Pearce-Kelly *et al* 2007). Two glasshouses at Melbourne Zoo easily house a population of LHI Stick Insects more than ten times the known population in the wild (Priddel *et al* 2003, D.Priddel pers. comm.), with very little financial contribution from either Melbourne Zoo or NSWDECC.

Once the appropriate approvals are obtained, LHI Stick Insects will be distributed to other institutions to further ensure the ongoing survival of the species. They will remain in captivity until the rodent eradication program, currently in the planning stage, is completed on Lord Howe Island. The LHI Stick Insect breeding program also illustrates that some invertebrate conservation programs are closely analogous to vertebrate programs when the species, such as the LHI Stick Insect, is high profile. It has the advantage that the project can act as a taxonomic surrogate for a number of vertebrate and invertebrate species within the same habitat, and as a flagship for threat abatement programs.

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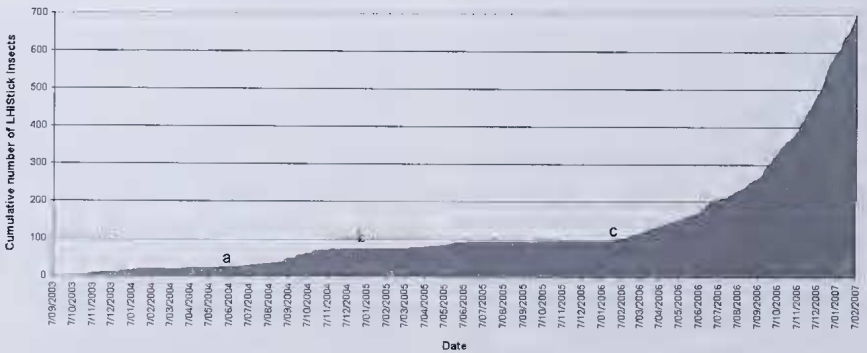

Fig. 3. Cumulative total of LHI Stick Insects hatched at Melbourne Zoo. Note that four new males were introduced in June 2004 (a); subsequent eggs began hatching six months later (b); and the next generation began hatching one year thereafter (c), leading to a dramatic population increase.

Norman Dowsett, Robert Anderson, Zoe Marston and other invertebrate keepers at Melbourne Zoo.

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Fig. 4. A pair of adult LHI Stick Insects in their daytime retreat. Note the numbered yellow plastic 'bee markers' glued to the back of the thorax. The male (lower) is facing the opposite way to, and with his legs over, the female.